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BIONOMICS OF *LACHESILLA NUBILIS* (AARON) (CORRODENTIA, CAECILIIDAE) *

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There are ten species of *Lachesilla* recorded from the United States. The following three have been found on corn (maize) during this work: *L. nubilis* (Aaron), *L. pedicularia* (Linné) and *L. forcepata* var. *major* Chapman, the first being the common species on corn around Urbana and Champaign, Ill.

Lachesilla nubilis has been recorded previously from Texas, Oklahoma, Tennessee, North Carolina and Florida between October 5 and January 2. During this study it has been taken in Illinois, Missouri, North Carolina, Kentucky, Tennessee and New Mexico. Various stages were taken throughout the year in twenty-three Illinois counties, and it probably occurs in all of them.

This species first attracted the writer's attention in October, 1938, when it was found with *Ectopsocus pumilis* (Banks) infesting dried corn stalks in the fields near Lawrenceville, Ill. However, this was not the first time *L. nubilis* had been taken in Illinois. It is said that a heavy infestation occurred about 1928 in seeds at the Stanner Seed House in Champaign. Some slides of this material were available and were determined as this species, but more specific collection data are wanting. Besides these two collection records from corn stalks and seeds, *L. nubilis* was taken from the following: elm and hickory brush pile, light trap, dried peach leaves, old cotton bolls, dried sorghum, budded oak and maple shrubs, dormant trumpet vine, okra, dried sunflower stalks and dry grass. The only host previously recorded is that of the holotype, taken in Southern Texas by Aaron (1) while beating a live oak thicket.

Complete descriptions of the adults may be found in the paper by Chapman (2). The males can be readily distinguished from the females by their large eyes, short upturned abdomen and strongly pigmented genitalia. Anomalies in wing venation are common in this species, and in some cases the same variation occurs on both forewings of an individual. The most common peculiarity is a fusion of M_2 and M_3+_4 at their bases. It is interesting to note that all three variations occurring in *Caecilius manteri* Sommerman (4) also appear in *L. nubilis*, such as the fusion of M_2 and M_3+_4 at their bases, the absence of M_3+_4 and the presence of an extra cross-vein between M and Cu.

Of the thirty-five species from the United States in the family Caeciliidae this is one of twenty-two for which both males and females are known. Of the ten species recorded for the genus *Lachesilla*, it is one of seven having both sexes known. Laboratory rearings and collections indicated that both males and females were produced in about the same numbers.

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MATING

Newly emerged females ignored or ran from the males when they touched them. Older females, especially those depositing non-fertile eggs, readily accepted the males. In one case, after mating had ceased, the female was removed and a virgin that had emerged the day before was put in the rearing tube. Copulation did not occur within the next hour and a half. In some of the experiments mating took place sometime within forty-eight hours after emergence of the adults, but in other cases it did not occur within a seventy-two hour period. The male apparently detected the female before actually touching her. Usually he darted behind the female and crawled on top of her abdomen causing her wings to spread a little, then grasped her abdomen with his fore and middle tarsi, and kept his hind tarsi on the corn sheath. The claspers of the male moved for a short interval, and then during mating both sexes remained almost motionless for two to ten minutes, only twitching their palpi now and then. Finally the female started to walk and braced her hind legs on the abdomen of the male, apparently trying to brush him off. Walking ceased for a few seconds, then after again trying to dislodge the male, the latter freed himself and both went about nibbling or cleaning their antennae.

OVIPOSITION

Eggs were laid during the summer on corn plants in the mid-rib tunnel formed by the drying leaf and also free on the leaves, especially where corn pollen had collected. Later in the fall eggs were laid most commonly on the inner surface at the base of the sheath; sometimes in the groove of the stalk; on the outside of the sheath at the base of the leaf, where there were numerous hairs; and on the husks of the ears.

The eggs are deposited singly, as a rule, but are sometimes found in groups of two or three, which is probably the result of the female's preference for depositing them in a crevice or against a surface obstruction. A few silk strands extend across the egg to the corn sheath, but they are difficult to detect so are probably of little use from the standpoint of covering. Females collected in the field and kept in individual rearing tubes, as described by Sommerman (3), had six different kinds of surfaces on which to lay eggs. Forty-six per cent of the time eggs were deposited on the hairy side of the corn sheath (normally the outside), twenty-five per cent on the smooth side (inside), eighteen per cent on the cork, nine per cent on the broken kernels, one per cent on the glass rearing cage, and one per cent on the cotton. In the colony cages the cut edges of the corn sheaths were a favorite site for oviposition.

Some egg counts were made from twenty leaves taken in the field Sept. 10, 1939, and averaged four eggs on the hairy upper side and one-half on the smooth lower surface. In this case it should be remembered that the mid-rib tunnel, an ideally protected spot, is included along with the upper surface. So it appears that late in summer, before the adults have crawled under the sheaths, the hairy side of the leaf is preferred for oviposition, which corresponds with the experimental evidence on surface preference mentioned above. On March 30, 1940, twenty sheaths were collected and egg counts made. The egg counts on the sheaths averaged 120 eggs on the smooth inner surface with eleven on the hairy outside. This indicates that apparently in the field, in fall, factors other than surface texture determine the location of the eggs.

Egg-laying started from one to five days after moulting to the adult, there being no decided difference in the preoviposition period of virgin and mated females. The oviposition period lasted from one to thirteen days for fertilized females and up to twenty days for virgins. Some females continued to live for six days after oviposition ceased, but they usually lived about two days.

The maximum number of eggs deposited by any fertile female was 134, but 70 to 85 seemed to be the usual number. During the oviposition period the

mated female deposited about eight eggs a day, but some laid as many as twenty-three. The peak of production occurred about the middle of the oviposition period when nine to fourteen eggs were commonly laid for four or five consecutive days. The usual number of eggs deposited by the virgins ranged between 37 and 52 during the entire laying period. These eggs never hatched. Although their oviposition period was half again as long as that of the fertile females, the number of eggs laid by the former was only about half that of the mated females. This suggests that mating is a stimulus to egg production, and it is substantiated to some degree by the oviposition records. When four pairs of adults were placed in rearing tubes the day they emerged, the average number of eggs laid per female in the next two days was thirteen, whereas the average number laid by four virgins in the two days following emergence was 2.5, and the average number laid by these females in the two days following the introduction of males was eighteen.

While ovipositing, the female walked nervously over a small area, nibbling on the fungus and often dragging the tip of her abdomen. Finally she stopped and remained motionless a few minutes with her ovipositor pressed to the corn sheath. After a shudder, she lifted her abdomen, and the egg remained attached to the corn sheath, the anterior end toward the female. The female turned around and touched the egg a few times with her labium, laying three strands of silk from the egg to the surface of the corn sheath. After wandering over the tube for forty minutes, she started to pace nervously across a small area again, curling her abdomen under and scraping the tip between two little ridges on the surface of the sheath. This time she remained motionless for eight minutes with her ovipositor pressed to the corn sheath. When she lifted her abdomen the egg remained in the groove, glued to the surface by a drop of liquid that quickly soaked in. Again she turned around over it a few times and attached about six strands of silk from the egg to the corn sheath. At this rate it would take a female about six hours to deposit the daily average of eight eggs.

EGG STAGE

The eggs are oblong oval, slightly flattened dorsally, with a shallow pestle-shaped groove on the dorsal surface bordered by a distinct ridge, a small knobbed projection on the anterior end, and a pit-like depression at the posterior end. The surface is covered with irregular hexagonal reticulations, except for the posterior three-quarters of the dorsal groove, which is usually smooth. The reticulations at the anterior end of the groove are smaller than the rest and more regularly hexagonal. The average length of ten eggs chosen at random was 0.441 mm. and the width 0.223 mm. The eggs were white when first laid, and as development progressed the vitelline membrane turned dark brown making the eggs appear a beautiful grey. This accentuates the whiteness of the reticulations and the dorsal ridge, giving the chorion a lacey aspect.

In the undisturbed egg the only visible sign of embryonic development is the change in color from white to grey. The shells were removed from three two-day-old eggs with a fine needle, and it was noticed that the dark brown pigmented region of the vitelline membrance extended only about three-quarters of the way down the sides of the egg. Two of these shell-less eggs hatched, and the dark eyes of the embryo could be seen the day before hatching. Hatching most often occurred seven days after the eggs had been laid, but a few required six or eight days.

From April to August collections of eggs were taken from the field and the non-hatched eggs were broken open to determine whether they were good or not. About seven per cent of these eggs were dried and could not have hatched.

HATCHING

It was difficult to determine exactly when the eggs would start to hatch. Several times eggs were found with the chorion open along the ridge at the an-

terior end but the nymphs did not emerge until a few days later. While examining some cold eggs just brought in from out-of-doors, two were observed to open suddenly along this ridge. Since nymphs did not emerge until six days later, it was thought that this cracking of the chorion was probably caused by the sudden change in temperature. This early cracking suggests that very little pressure is required to break the chorion, and that this region along the anterior ridge is definitely a weakened area, because the lids always lift up in one piece.

Three individuals were observed in the act of hatching and the process was as follows. As the so-called lid opened, the front was observed to be pulsating. The pronymph seemed to slip out of the shell in an effortless manner until it was about half way out. During this time the front was pulsating regularly. When viewed from the side, the tip of the egg burster moved out with the pronymphal membrane stretched tightly across it as the front pulsated in. The actual splitting of the membrane was not observed because it was difficult to distinguish when looking directly down upon it. It apparently split when the nymph was about half way out because the facets suddenly appeared distinctly and the setae on the head stood out. Then air bubbles were noticed passing into the alimentary canal. By a forward and backward swaying motion, the nymph freed itself almost completely from the pronymphal membrane. At this time bubbles of air were entering so rapidly they appeared to be in a continuous stream. The nymph was in a curved vertical position. The antennae were freed first and the legs immediately after. Air bubbles were no longer seen passing along the alimentary tract. After moving the legs and antennae a bit, the nymph bent over and stood beside the chorion. The pronymphal membrane, containing the egg burster (apparently on the inside), always remained protruding from the slit on the dorsal ridge of the egg.

POSTEMBRYONIC DEVELOPMENT

The nymphs are buff during the early instars and gradually become light brown. As some individuals get larger, they develop darker rings on the abdomen and a dark area on the vertex. From the third instar on, there is a distinct longitudinal stripe in the center of the abdomen. The antennae are eight-segmented in the first instar and thirteen-segmented thereafter. The wing pads appear on the third instar and the forewings approximately double their length with each successive moult. The sexes of the last (sixth) instar nymphs can be easily distinguished, the males having two small hook-like structures on the ventral side of the penultimate abdominal segment, which are lacking in the females. The duration of the six instar periods was as follows: first, 2.8 days; second, 2.2 days; third, 2 days; fourth, 2.1 days; fifth, 3.8 days and the sixth, 4.8 days. As has been found in the case of *Caecilius manteri* (4) and *Ectopsocus pumilis* (5) the last instar period is longer than any of the others. The measurements in the following table were averaged from ten alcoholic specimens in each instar.

Instar	First mm.	Second mm.	Third mm.	Fourth mm.	Fifth mm.	Sixth mm.	Adult mm.
Head width	0.215	0.272	0.333	0.405	0.484	0.601	0.625
Antennal length	0.338	0.457	0.543	0.704	0.933	1.310	1.855
Forewing length			0.102	0.196	0.370	0.810	2.755

The complete nymphal period required seventeen to nineteen days. The adult stage averaged about fifteen days. The total length of all the life stages was about forty-one days.

MOULTING

Part of the time the nymphs ate the exuviae, this probably depending on the other food material available, but the adults made a practice of eating their last exuviae. This habit made it difficult to determine moults in the early

instars, especially if the nymphs happened to be in such a position that measuring was not possible. In almost every case exuviae were in a vertical position with the head down. Moulting was the same as that described for *C. manteri* (4) and *E. pumilis* (5). The epidermis split along the top of the thorax and head. The nymph arched up with the antennae held down along the sides of the body. The head was finally freed, and by swaying forward and backward the nymph gradually rose until it was actually resting on the tip of its abdomen. Then the antennae and legs were released. All this time air bubbles were being swallowed and the abdomen was stretching out. Finally the nymph bent over and stood beside the exuviae. Then the abdomen contracted to its normal length. A few nymphs were timed while moulting, and it required five to eight minutes. Immediately after moulting the nymph is light in color and pigmentation proceeds rather slowly. In the case of the adults, sometimes all the pigmented structures were not completely darkened until the following day. After the third instar one can determine when moulting will occur, because the thick wing-pads stick out from the body the day before moulting.

HABITS

Under laboratory conditions the nymphs and adults eat fungi, the epidermis and mesophyll of the corn sheaths, corn pollen, embryo and starch of corn kernels, exuviae, dead of their own kind, eggshells, eggs of dermestids when fed them, and the starved females eat their own eggs. It is doubtful if the nymphs and adults eat more than the fungous growths on the corn stalks under field conditions during late fall, spring and early summer. However, in the fields during late summer, when corn pollen was coated on the leaves, adults were observed feeding upon it. It might be that the diet of those individuals frequenting corn at this time of year consists mainly of pollen, since the corn stalks and sheaths are still green, and the leaves so recently dried that fungus growths are not at all common.

The silk deposited by the nymphs and adults was rather conspicuous, but very little was put over the eggs. Some of the individuals in the glass rearing tubes were observed having difficulty endeavoring to walk on the smooth glass. They touched the labium to the glass, attaching a silk strand to a spot, then reached up and attached the strand again. They continued to zig-zag up the glass, making a ladder to walk on.

This species reacted to moisture the same as *Caecilius manteri* (4) and *Ectopsocus pumilis* (5). The insects sunk their mandibles into the moist cotton plugs and readily drank the water. After a suitable rearing technique was worked out (3), it was relatively easy to rear this species.

On the corn stalks in the field, *L. nubilis* seems to prefer the sheaths between two and five feet up on the stalk, being most common between the three and four foot region. This is probably because the lower sheaths fit too snugly and the extreme upper ones are wrapped completely around the stalk, thus allowing entrance only at the tip, or if they are open, are so much so that the caeciliids would be exposed to the elements.

OVERWINTERING

The nymphs and adults were most numerous on the dried corn stalks in October, November and early December. Some sections of a particular corn patch, more heavily infested than others, contained as many as twenty-nine adults on one individual stalk, and nymphs were estimated to number from fifty to one-hundred per stalk. At Urbana, Ill., from January to March, eggs could always be found and occasionally nymphs. The nymphs, though seldom taken during this period, might have been more abundant, because they were inactive and could have been easily snapped from the sheaths as they were broken off.

In the spring of 1939, eggs on sheaths left in a screen cage outside the window started to hatch March 16, and newly hatched first instars were found in the field at Savoy, Ill., on March 21. During the spring of 1940, the eggs

started to hatch in the field April 1, and by April 15 hatching was well under way and continued until early May. So it is obvious that winter is usually passed in the egg stage in this vicinity, with a few nymphs managing to survive on the corn sheaths also.

Adults, matured from overwintering nymphs, were first found in the spring of 1939 on April 23, and in 1940 on April 2. However, it was not until the last few days of April in either year that new eggs were found on the sheaths. Adults and mature nymphs were common May 20, 1940; it was assumed that the individuals hatched from the overwintering eggs had reached maturity. Freshly laid eggs and young nymphs again became numerous the first week of June. Adults and nymphs were commonly found again during the last week of June on the old dried corn stalks still standing in the field. About this time the life stages were no longer clear cut, there being eggs, nymphs and adults continuously. During the first three weeks of July, eggs, nymphs and adults could be found on the old stalks standing in neglected corn fields. The corn in these observation fields was cut and burned the last week of July, but this information suggests that the caeciliids might survive the summer on the dried corn if it were not cut and burned. If that is so, they might migrate later in the season to the more favorable, newly dried corn close by.

Corn planted in the early spring in the Entomology greenhouses was dried and brown by the third week of July. During May, June and July, the ventilators were continually open and a fair infestation of this species had built up on the dried corn during this time. The adults had apparently been attracted to it from out-of-doors as soon as conditions became favorable. This suggests that they do migrate from one place to another more favorable. So it is possible that the spring generation developing on the corn debris in plowed fields migrates to some other habitat.

A few adults and fresh eggs were found on the drying leaves of new corn August 1, 1940. Records from Missouri show that fields of corn dying from cinch bug injury in late July were infested with this species. This information also indicates migration from other quarters.

During August and early September the adults frequent the leaves, especially the pollen-coated ones, and are found running up and down the mid-rib tunnel in the drying leaves. From the latter part of September on, as the stalks dry out, the conditions between the sheaths and stalks become more favorable and it is then that the population reaches its peak.

Collections made in Raleigh, N. C., from September to the first week of January suggest that the psocids might overwinter there in all stages in the corn-fields. The infestation seemed to increase as the season progressed; unless sub-freezing weather came in January, it seems likely that activity and development might only be retarded in the winter and not actually stopped.

Field observations in Urbana showed nymphs and adults of this species to be sluggish when the temperature reached 38° F. but fairly active if disturbed. When the outdoor temperature was as low as 32° F., a few nymphs moved slowly when disturbed. At slightly lower temperatures the nymphs were motionless. All individuals immediately became active when brought into a warm room.

PARASITISM

Eggs of various ages, from both field and laboratory, were subjected to the adults of *Alaptus caecilii* Girault, determined by A. B. Gahan of the U. S. Bureau of Entomology and Plant Quarantine. These mymarids emerged from the eggs of *Caecilius aurantiacus* Hagen, and just as a matter of curiosity, the eggs of *Lachesilla nubilis* were exposed to them. Ninety-six per cent of the eggs hatched and normal nymphs developed, so it is obvious that this species was not successfully attacked by the egg parasite, *Alaptus caecilii*.

SUMMARY

Various stages of *Lachesilla nubilis* have been taken in the southern states east of the Rocky Mountains as far north as Missouri, Illinois and Kentucky. Both sexes are known, and the sex ratio is 0.5. The eggs are white when first laid but turn grey as development progresses, and the surface is reticulate. The eggs are laid singly and lack any appreciable covering of silk. The nymphs emerge by pushing up the so-called lid at the anterior end of the egg. Hatching occurs seven days after the eggs have been laid. The antennae are eight-segmented in the first instar and thirteen-segmented thereafter. The wing-pads appear on the third instar, and the forewings about double their length with each successive moult. During moulting the nymphs are in a vertical position with the heads down. The nymphal period requires about 17 to 19 days and the adult stage lasts about 15 days. The usual life span, including the period within the egg, is about 41 days. The nymphs and adults feed on various parts of the dried corn plants and on the fungi growing there, and starved females eat their own eggs. The silk deposited by the nymphs and adults in the rearing cages was conspicuous. In the more northern states where this species is found, winter is passed mainly in the egg stage.

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INFLUENCE OF WATER CURRENT ON CASE WEIGHT IN LARVAE OF THE CADDISFLY, *GOERA CALCARATA* BANKS

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INTRODUCTION

The larvae of certain Trichoptera are known to fashion into their cases structures to which a "ballast" function has been ascribed (Stuck, 1900; Buchner, 1905; Rousseau, 1921; Lloyd, 1921; Needham and Lloyd, 1937). Of forms living in the Ithaca, New York, region the cases of *Stenophylax scabripennis, Halesus guttifer, Neophylax,* and *Goera calcarata* are offered as examples. The term "ballast" has been used to imply a balancing as well as a weighting purpose depending upon the particular species under discussion. Rousseau (1921) in describing the general types of caddis cases says ". . . . in the absence of current, they (the cases) do not in general offer such adaptations as those which we find in the larvae living in moving water. These last can resist the current, the eddies, and avoid being dragged about by them. And in fact, one may say that nearly always their cases are built of such material as pebbles, sand, gravel, i. e., that giving the most weight; in the Goerines, for example, they offer bilaterally on the outside some large heavy materials arranged in such a manner that the lower surface is perfectly applied against the stone upon which one finds the larva, ... the larvae living in the rapid water always preserve markedly

the characters of bottom forms, weight." Buchner (1905) adds further with regard to the placement of ballast stones in *Goera*, "These stones hinder the floating away, to be sure, but not by their weight; but especially by their arrangement. In these larvae we see that the best means against being floated away is not the attachment of ballast and spreading devices, but on the contrary, the structure type that offers no surface to the impact of the water. The stones always lie such that the water must glide along above them . . . ."

The cases of nearly mature larvae of *Goera calcarata* are about 10 mm. long, and consist of a tube of about 2.5 mm. in diameter of sand grains firmly cemented together; usually two pairs of large "ballast" stones are cemented laterally. The species is abundant in many of the rapid upland streams in the vicinity of Ithaca. Invariably they are found over rocky or gravel bottom, in

Table I. Weight in milligrams of typical completed cases of *Goera calcarata* built in lentic and lotic environments.

Lentic			Lotic		
After 5 days	After 10 days	After 30 days	After 5 days	After 10 days	After 30 days
105	93	48	104	98	89
99	85	82	124	113	90
99	93	58	101	79	72
69	61	71	66	78	81
85	64	79	102	89	92
116	79	66	74	88	89
87	86	61	95	99	90
109	68	71	102	105	72
59	98	105	93	103	81
72	79	89	109	91	92
72	76	81	122	86	73
86	102	94	96	102	101
	52	63	99	111	98
	64	111	96	72	151
	81		96	114	78
	76		75	85	80
	71			82	78
	101			60	101
	88			84	80
	85			81	100
				76	83
				67	81
				87	81
				68	
				81	
Mean=81.3 plus or minus 16.4 mg.			Mean=90.4 plus or minus 15.8 mg.		

the pools with moderate flow, as well as in the riffles, but only infrequently are they present in the dead back-waters. The larvae are often plainly visible, for they are found exposed on the surface of the stones on the stream bottom. Under favorable conditions a score or more larvae may be collected from a flat stone about a foot across. The orientation of the larvae may or may not be in a head up-stream position depending upon the rapidity of the flow and the eccentricities of the current direction caused by bottom deflections. The larvae move about on the tops or sides of the rocks with cumbersome ease. Observations indicate that the sole mechanism which keeps them from being swept away by the current is their foot-hold, for when disturbed, they rapidly withdraw within their cases and are immediately washed from the elevated positions.

It was the latter observation which prompted the writers to conduct an experiment upon the possible influence of current on case weight. Stating the problem more explicitly: will larvae of *Goera calcarata* Banks, under experimental conditions, build significently heavier cases in a rapid water (lotic) environment than in a stagnant (lentic) water one?

MATERIALS AND METHODS

From other work it was known that larvae of this caddis would live and build new cases under the artifically imposed conditions of a pan of shallow water. This work also showed that the time at which larvae began or completed new cases varied considerably, that some larvae would not build new cases, and that the completed cases were not all of typical construction, even after the larvae had been allowed to work on them for a considerable period.

The experiment was carried out in a trough at the Cornell University Experimental Fish Hatchery. A rearing trough 96 by 14 inches was divided in half lengthwise. An inch dam was placed at the head of the section, the left half of which had a strip about 1/8 inch wide removed from the bottom. When the pool above the dam was filled with water, and the flow from the delivery valve regulated so that a constant level was maintained, the head of water above the dam caused an even flow to move swiftly from below the left side of the dam. The right half of the section was completely boxed in around the sides

Table II. Weight in milligrams of a random sample of typical and atypical cases built by *Goera calcarata*. Data used in analysis of variance.

	Cases built after 5 days		Cases built after 10 days		Cases built after 30 days	
	Typical	Atypical	Typical	Atypical	Typical	Atypical
	59	79	86	68	79	72
	69	86	68	83	71	101
Lentic	99	38	79	60	63	97
	105	56	76	83	81	95
	72	54	76	98	111	51
Mean	80.8	62.6	77.0	78.4	81.0	83.2
	96	64	82	143	98	78
	109	50	89	112	151	70
Lotic	93	96	88	70	90	79
	95	69	102	51	92	79
	96	73	113	101	78	78
Mean	97.8	70.4	94.8	95.4	101.8	76.8

and sealed so that when the dam at the head was adjusted to permit a slight leak into the enclosure on the right, it filled and maintained a level comparable to that of the water above the dam; the possible influence of the incoming stream was eliminated by a series of baffles. On the bottom of each half was spread an even layer of sand and gravel. Thus the left side of the section simulated a rapid riffle, while the right was essentially a stagnant backwater.

The experiment was repeated three times, the first running for five days, the second replicate for ten, and the third for 30 days. The experiments ran from November 3 to December 20, 1940. Sixty larvae, thirty in each environment, were used in each experiment and none were required to construct more than one new case. At the end of each of the periods, all larvae were taken out and their cases removed. The cases were then classified according to the following categories: complete or incomplete, and if complete, typical or atypical. The basis for the classification was largely the method of case construction of the larva. A loose, flimsy covering of sand grains was first built. This was accomplished in about twelve hours. Then starting at the head end, the larvae began a firmly cemented tubular case, to which the "ballast" stones were attached as the tube reached appropriate size. Cases of flimsy construction, frequently attached to the bottom, were considered incomplete and discarded. Completed cases were not attached and of rigid construction, the typicalness being judged by the

regularity of construction relative to the original pattern, by placement of ballast structures, and by the presence of a semi-sealed posterior end. The cases were air-dried for a week and then weighed to the nearest milligram on an analytical balance. Statistical methods employed were those given in Snedecor, 1940.

RESULTS AND CONCLUSIONS

A summary of the completed cases constructed by the caddis larvae during the three trials is as follows:

Duration of trial	5 days		10 days		30 days	
Environment	Lentic	Lotic	Lentic	Lotic	Lentic	Lotic
Number of cases completed out of 30 larvae	23	28	28	30	20	24
Per cent judged as of typical construction	57	57	71	83	70	75

The mean weight of the typical cases built by the larvae in running water was 90.4 milligrams, 9.1 milligrams more than the mean of the cases built in the lentic environment (about 10 per cent heavier). This difference may be shown to be highly significant (one per cent level) by appropriate statistics, but such treatment does not take into consideration the length of time required to build the cases nor the typical nature of the individual cases.

To investigate the above factors an analysis of variance was conducted on a random sample of five items from each of the subclasses (the least number of items occurring in a subclass in the total data at hand); the data are given in Table II. These tests showed that there was no significant difference in weight between the cases constructed after the lapse of different time periods (i. e., that more weight was not added to the cases, for example) and that differences in weight between typical and atypical cases were likewise non-significant, The mean difference between cases built in lotic and lentic situations, however, was significant at the 5 per cent level, the reduced significance being due to the smaller number of items used in the test.

Thus the conclusion is warranted that under the conditions of the experiment, larvae of *Goera calcarata* built significantly heavier cases in running water than in stagnant water.

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NOTE

A NEW RIODINID RECORD

In the fall of 1940 Mr. H. A. Freeman, then of Lancaster, Texas, but now of White Deer, Texas, sent me four specimens (three males, one female) of *Apodemia walkeri* Godman and Salvin (1886, Biologia Centrali-Americana I:468, Tab. XLVII, figs. 13, 14) taken at Brownsville, Texas, between June 2 and June 9, 1940. This Mexican species has not heretofore been recorded from the United States.

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A REVISED SYNOPSIS OF NEARCTIC *THAUMATOMYIA* (=*CHLOROPISCA*) (DIPTERA, CHLOROPIDAE)*

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Flies of the genus *Thaumatomyia* Zenker (=*Chloropisca* Loew) are small but common, and identification is frequently requested for faunal, ecological or other studies. Their highly polished, glabrous, usually yellow and black striped appearance stands out sharply among the many kinds of small dark flies captured by sweeping. A synopsis of the North American species (as *Chloropisca*) was published by the writer in 1936 (Canad. Ent., 68:170-177), and a few corrections in nomenclature and additions to distribution were included with other notes in 1938 (Jour. N. Y. Ent. Soc., 46:417-420). Since then, the study of many hundreds of specimens has made it possible to offer a revised key to include some new forms, new records, and the discovery of sexually dimorphic species. It has also seemed advisable to append an explanation of the writer's adoption of the name *Thaumatomyia* to replace the more familiar *Chloropisca*.

REVISED KEY TO NEARCTIC SPECIES OF *THAUMATOMYIA*

1. Disk of the mesonotum entirely black, without stripes, although in teneral specimens one may see an underlying pattern ..... 2.
   Mesonotum with broad black or reddish stripes ..... 5.
2. Legs predominantly black (western species) ..... *T. pullipes* (Coq.)
   Legs yellow, except for a few distal tarsal segments ..... 3.
3. Frontal triangle large with very convex sides and obtuse apex, occupying almost the entire front; large species, 3.5 mm. (eastern species) ..... *T. obtusa* (Mall.)
   Triangle narrow, small, the apex more or less acute; smaller species ..... 4.
4. Triangle long and narrow, the sides straight; cheeks subequal in width to the third antennal segment; 2.5-2.75 mm. (Canadian zone) ..... *T. grata* (Loew).
   Triangle narrow but with convex sides; cheeks linear; 1-1.5 mm. (eastern species) ..... *T. parviceps* (Mall.)
5. Mesonotum with reddish stripes ..... 6.
   Mesonotum with black stripes ..... 8.
6. Mesonotum and scutellum with highly polished, glabrous appearance as in common *T. glabra*, the sparse hairs so minute as to be visible only under high magnification; notopleural bristles apparently 0+1, only the lower posterior bristle black and distinct (California) ..... *T. rubrivittata* Sabrosky.
   Mesonotum and scutellum rather densely covered with short but distinct hairs set in fine punctures which prevent a smooth polished appearance; notopleural bristles 1+2, all being black and distinct, although fine ..... 7.
7. Large, stocky species (2.75-3 mm.); frontal triangle entirely or chiefly deep yellow to orange, at most the basal corners darkened, with several irregular rows of distinct punctures along each side; front broad, its length and width subequal (western) ..... *T. rubida* (Coq.)
   Smaller, slender species (2-2.5 mm.); triangle commonly orange with narrow black lateral margins, rarely in pale specimens entirely orange, smooth and without the several rows of distinct punctures; front not appearing as broad, the length greater than the width, as 1.2·1 (widespread, varying from pale reddish to black) ..... *T. pulla* (Adams).
8. Cheeks linear, narrower than the diameter of a palp ..... 9.
   Cheeks broad, at the very least much broader than a palp, usually subequal to or wider than the breadth of the third antennal segment ..... 11.

*Journal Article No. 603 (n. s.) from the Michigan Agricultural Experiment Station. In addition to the numerous sources of material which are indicated in the records, the writer wishes to express particular appreciation to Drs. H. B. Hungerford and R. H. Beamer of the University of Kansas, who have made available large quantities of especially significant material from western and southwestern states.

9. Frontal triangle entirely bright yellow except for the black ocellar tubercle; males (female unknown to me in *sulfurifrons*) ..... 10.
..... Frontal triangle predominantly black, or mottled with black and yellow; third antennal segment entirely black; females (southwestern species) ..... *T. apache* Sabrosky

10. Third antennal segment entirely black; dorsum of third abdominal segment chiefly yellow, with three black spots; males (southwestern species) ..... *T. apache* Sabrosky
..... Third antennal segment orange on the basal half; dorsum of third abdominal segment with a broad black transverse fascia, leaving only a narrow yellow posterior margin (Neotropical species) ..... *T. sulfurifrons* (Duda)

11. Cheeks very broad, 1½-2 times the breadth of the third antennal segment and over half the height of an eye ..... 12.
..... Cheeks not strikingly broad, usually subequal to or only slightly broader than the third antennal segment and approximately 1/4 to 1/3 the height of an eye ..... 13.

12. Palpi black; frontal triangle broad and smooth; mesonotum and scutellum with a polished, glabrous appearance; legs predominantly black in the females, yellow in the males (western) ..... *T. appropinqua* (Adams)
..... Palpi yellow; triangle narrower at the base, more or less punctured and roughened laterally; mesonotum and scutellum typically with numerous short but distinct hairs; legs yellow in both sexes (Palaearctic species, Alaska) ..... *T. trifasciata* (Zett.)

13. Frontal triangle basically orange, often more or less marked with black on the basal corners or along the sides; mesonotum and scutellum densely covered with short but distinct hairs set in fine punctures which prevent a polished appearance ..... 14.
..... Frontal triangle predominantly polished black with bright yellow basal angles, the yellow sometimes extended to include the lateral portions of the triangle; mesonotum and scutellum usually with a polished, glabrous appearance ..... 15.

14. Triangle dark orange, typically with blackish median stripe and two lateral stripes extending from the basal angles halfway to the apex, each side with several irregular rows of distinct punctures; larger, stocky species; 2.75-3 mm. (Canadian zone) ..... *T. annulata* (Walker) (=*variceps* Loew)
..... Triangle chiefly orange, typically with a narrow black margin the full length of each side, but in dark specimens the lateral stripes are broad and the entire triange is darker than usual; the surface of the triangle not roughened or punctured; smaller species, 2-2.5 mm. (dark form found in high altitudes; the species is ordinarily reddish with dark red stripes ..... *T. pulla* (Adams)

15. Fore metatarsus entirely black, occasionally yellow at the extreme base; frontal triangle large, broad basally and with straight sides; mesonotum and scutellum apparently glabrous; typical form (widespread) ..... *T. glabra* (Meigen)
..... Fore metatarsus, and sometimes more, yellow (varieties of *T. glabra*) ..... 16.

16. Triangle narrow, the sides strongly concave on the basal half; mesonotum and scutellum typically with a glabrous appearance (northeastern) ..... *T. glabra* var. *bistriata* (Walker)
..... Usually one or both characters not as above, or the cheeks quite narrow ..... *T. glabra* unnamed varieties.

Thaumatomyia rubrivittata n. sp.

Yellow species with reddish mesonotal stripes, and highly polished, glabrous habitus.

♂, ♀. Yellow, the ocellar tubercle, clypeus, distal half of the third antennal segment, a large oval spot along the lower margin of the mesopleura, the dorsum of the abdomen except for the sides and apex, and narrow posterior margin of the fourth segment, and the fore tarsi, black or blackish brown, the distal segment of the other tarsi and the occiput centrally somewhat browned. The three broad mesonotal stripes and the metanotum dark reddish, in a few specimens irregularly tinged with black, usually with a black spot on each lateral stripe where it adjoins the humeral callus. Triangle entirely yellow except for the ocellar tubercle, at most with a narrow reddish median streak anterior to the ocelli.

Front usually slightly longer than broad, and from above wider than an eye. Frontal triangle long, extending up to the anterior margin of the front, the sides straight, its surface with only one row of pale minute hairs along each side, but the piliferous punctures weak and not interrupting the polish of the triangle. Third antennal segment slightly longer than broad, the arista minutely pubescent, appearing bare under low magnification. Cheeks broad, subequal to or usually slightly wider than the breadth of the third antennal segment and equal to one-third the height of the eye. Fine hairs are present on the mesonotum and scutellum, but they are pale, minute, sparse, and inconspicuous, as are the punctures from which they arise, hence in most specimens the habitus is like that of *T. glabra* (Meigen). Mesopleura with rather numerous pale hairs on the posterior half. Apparently only 0+1 notopleural bristles, with only the lower posterior bristle black and distinct, the others pale yellow and scarcely differentiated from hairs. Sensory area on the hind tibia large, over one-third the length of the tibia. Wing venation as usual in the genus.

Length, 2-2.25 mm.

Holotype, male, *allotype*, female, and 9 *paratopotypes* (5 ♂, 4 ♀), Antioch, California, Oct. 18, 1936 (R. C. Dickson), received for study through the kindness of Mr. G. E. Bohart. To be returned to the University of California for ultimate deposit in the Collection of the California Academy of Sciences. *Paratypes*: *California*: ♀, Davis, June 9, 1936 (R. M. Bohart) [Univ. Calif.]; ♀, Rosamond, July 23, 1940 (R. H. Beamer); 2 ♀, Palmdale, July 22, 1940 (D. E. Hardy); ♂, Lone Pine, July 28, 1940 (R. H. Beamer) [all, Snow Colln., Kans. Univ.].

T. rubrivittata is the third known Nearctic species of the genus having red stripes, the others being *T. pulla* and *T. rubida*. Both of the latter are distinctly and rather densely covered with hairs on the mesonotum and scutellum, whereas *rubrivittata* is one of the highly polished and apparently glabrous species in which the hairs are sparse and minute and may be seen only under higher magnification. It is much more closely related to *T. glabra* (Meigen), though the reddish color pattern might cause it to be linked with the other two species. In addition to the hairs, *T. rubida* is a larger, stockier species (2.5-2.75 mm.), with a broad front, the breadth and length of the front being subequal, the triangle is decidedly punctured with about two irregular rows on each side, and 1+2 black notopleural bristles are developed. *T. pulla* is about the same size as the new species and is superficially quite similar, but the frontal triangle is regularly margined with black along each side, and there are 1+2 black notopleural bristles.

A comparison with European and Neotropical species showed that all the species with reddish mesonotal stripes (*T. rufa* Macq. of Europe, *T. gemina* Becker of South America, etc.) fall in the class with distinct hairs on the mesonotum and will not be confused with the present form.

Thaumatomyia apache n. sp.

Near *T. sulfurifrons* Duda, of which it may prove to be a subspecies, but with entirely black third antennal segment, chiefly yellow third abdominal seg-

ment in the males, and slightly larger size; frontal triangle yellow in the males, but predominantly black in the females.

♂. Highly shining, bright yellow species with the following black markings: third antennal segment, ocellar tubercle, occiput centrally, three broad mesonotal stripes and two narrow supraalar vittulae, four pleural spots (on meso–, ptero–, sterno–, and hypopleura), metanotum, a small round spot in each anterior corner of the dorsum of the second abdominal segment, a small lateral spot and a larger fusiform transverse spot on the middle of the third segment (sometimes only a small median spot), and broad fasciae on the fourth and fifth segments. Arista brown to blackish. Legs entirely deep yellow, the tarsi slightly browned at their extreme apices.

Third antennal segment subquadrate. Front decidedly narrower than an eye. Triangle long, attaining the anterior margin of the front, the sides straight, a row of pale inconspicuous hairs set in fine punctures along each side. The fine hairs rather thickly set on the mesonotum and scutellum are pale but quite conspicuous. Mesopleura with a few pale hairs on the posterior half. Notopleural bristles 1+2, but the anterior bristle is pale yellow and not very apparent. Wings with very broad anal area, the hind crossvein twice as long as the fore crossvein, the discal cell thereby notably broader at the distal end than at the proximal, the fore crossvein opposite a point well beyond the middle of the cell, the distance between the crossveins subequal to the length of the hind crossvein. Length, 2-2.3 mm.

♀. Differs from the male as follows: frontal triangle brownish black anterior to the black ocellar area, the color interrupted along each side by pale spots from which arise the pale hairs on the surface of the triangle. At its darkest the triangle is predominantly black with large yellow basal corners, at its palest there is a median black stripe approximately equal in width to the black ocellar spot. Second abdominal segment with a broad black fascia across the entire dorsum, narrowly yellow along the posterior margin and on the sides. The discal cell is only slightly broadened towards its distal end, the fore crossvein is only slightly beyond the midpoint of the discal cell, and the crossveins are separated from each other by a distance equal to 1½ times the length of the hind crossvein. Length, 2.25-2.5 mm.

Holotype, male, and *allotype*, Chiricahua Mts., Ariz., July 4, 1940 (R. H. Beamer). In the Snow Entomological Collection, University of Kansas. *Paratopotypes*, 53 ♂, 99 ♀, same data [Kansas Univ. and the writer's collection]. *Paratypes*: *Arizona*: 3 ♂, 3 ♀, Sunnyside Canyon, Huachuca Mts., July 9, 1940 (R. H. Beamer, L. J. Lipovsky, E. E. Kenaga); ♀, Tubac, Aug. 21, 1935 (R. H. Beamer); 3 ♂, 2 ♀, Santa Rita Mts., 5-8,000 ft., June (F. H. Snow) [All from Snow Colln., Kans. Univ.]; ♂, Pinery Canyon, Chiricahua Mts., alt. 6,000 ft., June 5, 1919 (Whitmer Stone) [Acad. Nat. Sci. Phila.]. *Texas*; 2 ♂, Weslaco, March 25, 1930 (S. W. Clark) [Texas A. & M. College Colln.]; 8 ♂, 9 ♀, Bexar Co., May 5, 1938, "swept from peach" [U. S. Nat. Mus.]. *Mexico*: 2 ♂, "Mex" (no locality), Nov. 28 (S. J. Allende) [U. S. Nat. Mus.].

The holotype male of *T. sulfurifrons* Duda, Farm La Caja, 8 km. west of San José, Costa Rica, Apr. 15-June 20, 1924 (H. Schmidt) [Zoologisches Museum, Hamburg, Germany], has the third antennal segment orange-yellow on the basal half, and the third abdominal segment with a broad black fascia as in the female of *T. apache*.

Up to 1936, the writer had seen only four specimens of *Chloropisca* with yellow frontal triangle, identifying them tentatively as *C. sulfurifrons* Duda (1930), described from Costa Rica. The pattern was so unusual in the genus that the identification seemed quite probable, in spite of the inadequate description in Duda's monograph. In 1937, the type of *sulfurifrons* was studied, but the few differences from Arizona material seemed so trivial as to be accounted

for by range of variation. However, an unusually fine series from southern Arizona [Snow Colln., Kans. Univ.] shows these few points to be consistent and therefore possibly of greater value than at first supposed. Unfortunately no additional Central American examples have been seen and it is impossible to say whether the form described above is a new species or subspecies, or only a variety. It has been the writer's experience in this family that seemingly minor differences, at first attributed to variability, have often proved to be consistent specific criteria. Naming the southwestern form will enable the accumulation of definite records which may finally indicate its proper status.

The long series from Arizona proved to be significant also in showing the sexual dimorphism in the color of the frontal triangle. The very striking character of bright yellow triangle (with black ocellar tubercle) was found only in the males, whereas the females of the species had a broad black median stripe. Undoubtedly the females have been confused with the common and widespread *T. glabra* (Meigen) in years past, though they are quite easily distinguished by their linear cheeks and narrower front. The case in hand is a splendid illustration of the great advantage in having a long series of specimens for study, notably when the problem of recognition is complicated by sexual dimorphism or by variability.

It is not known whether *T. sulfurifrons* shows a similar dimorphism between the sexes, but in view of this discovery, the possibility should be borne in mind by anyone who examines Neotropical material.

Thaumatomyia appropinqua (Adams)

In his previous review of the genus (1936), the writer resolved the confusion between the two black-legged species found in the western United States, *appropinqua* Adams and *pullipes* Coq., restricting the latter name to the species with entirely black mesonotum, the former to the species with broad stripes.

A good series recently received from Prof. M. T. James of Colorado State College (7 ♂, 8 ♀, Ft. Collins, Colo.) called attention to the hitherto unreported sexual dimorphism in *appropinqua*. The black-legged form proves to be the female of the species, whereas the male has yellow legs with only the fore tarsi and the distal third to half of the fore tibiae black. Consequently, the male is similar to the ubiquitous species *T. glabra* and undoubtedly has been included with that species in past determinations, often labeled as a variant. Because one seldom sees more than a lone speciment or two of *appropinqua* at any one time, and because females are usually more frequent in ordinary collecting, the dimorphism had thus far passed unnoticed.

The yellow-legged males of *appropinqua* are readily separated from *glabra* as follows: Palpi black; cheeks very broad, approximately twice the width of the third antennal segment and over half the height of an eye. . . . *T. appropinqua*. Palpi yellow; cheeks narrower, subequal to or slightly broader than the third antennal segment and about one-third the height of an eye. . . . . *T. glabra*.

Neallotype: male, Morton Co., Kansas, alt. 3200 ft. (F. H. Snow) [Kan. Univ.]. Two males from Morton County bear the same data as a large portion of the original type series of *appropinqua*, and it is therefore appropriate to select one of them as neallotype.

Distribution: western. Many additional localities in its recorded range are now represented in identified material. Notable records include Kennewick, Wash., April 28, 1939 (K. Gray) [Ore. State Coll.]; Campo, Calif., July 18, 1940 (R. H. Beamer) [Kans. Univ.]; Sunnyside Canyon, Huachuca Mts., Ariz., July 9, 1940 (D. E. Hardy, L. J. Lipovsky) [Kans. Univ.]; Swift Current, Saskatchewan, May 28-30, 1937 (A. R. Brooks) [Dominion Ent. Lab., Saskatoon, Sask.].

Thaumatomyia trifasciata (Zett.)

This Palaearctic species is here recorded from North America for the first time, based principally on an excellent series of 51 specimens (25 ♂, 23 ♀, 3 ?) collected at Savonoski, Naknak Lake, Alaska, July 25-31, 1919, and August, 1919 (James S. Hine) [Hine Colln., Ohio State Univ.]. The series was large enough to demonstrate sexual dimorphism in the color of the dorsum of the fifth abdominal segment, which was entirely yellow in the males, but brown on the basal half to three-quarters in the females.

From notes made some years ago I find that there are five specimens of the species standing under a manuscript name in the U. S. National Museum. These were collected by T. Kincaid on the Harriman Expedition to Alaska, as follows: Muir's Inlet, June 12, 1899; Virgin's Bay, June 26, 1899; and Saldovia, July 21, 1899. I have before me also a small series from Rapids, Alaska, July 18, 1938 (C. B. Philip), and single specimens from Electron, Wash., May 25, 1936 (W. W. Baker) [Baker Colln.]; Churchill, Manitoba, Aug. 2-9, 1937 (D. G. Denning) [Univ. of Minn.]; Indian Head, Sask., July 1, 1937 (A. R. Brooks) [Dominion Ent. Lab., Saskatoon] and Hopedale, Labrador, Aug. 19, 1935 (W. W. Perrett) [British Mus. (Nat. Hist.)].

Thaumatomyia glabra (Meigen) and related forms

T. glabra is the commonest species of the genus and almost cosmopolitan in its recorded distribution. Its characteristics seem to vary so widely, especially the extent of the color pattern, that extreme forms have been recorded as definite varieties. However, the existence of numerous intergrades and different combinations of variables has resulted in the long standing conclusion that all belong to one widespread and extremely variable species. Undoubtedly this concept has served in the past to hide the identity of such forms as the female of *T. apache* and the yellow-legged male of *T. appropinqua*.

Even after properly distinguishing such definite forms, however, there still remains the vast array of "variants" which most workers would assign to *T. glabra*. For some time it has seemed to the writer that there were recognizable segregates in this complex, but it has been impossible to draw up any good distinctions. At times a particular series seemed so distinct that it deserved at least varietal if not sub-specific status, but in every case the study of additional lots of specimens provided so many intermediates that the conclusion had to be abandoned. Not one character was found which was consistent in all specimens, and when several characters were considered, the various combinations defied all attempts to segregate them into recognizable units.

In spite of this apparently hopeless situation, the constant recording of all variants has showed that certain "variations" may have some connection with certain faunal zones or regions. For example, individuals with rather distinct hairs on the mesonotum and yellow fore metatarsi are commonly found in material from the western and far western states, and the form known as *glabra* var. *bistriata* Walker (= *clypeata* Mall.) is northeastern. However, all these forms appear to exist beside typical *glabra*, though only in parts of its range, and it is possible that they merely represent responses to environmental conditions such as lower temperatures. In some material, notably from Colorado, there were indications that the hairy form occurs at higher altitudes than typical *glabra*, but the available data are neither complete nor conclusive, and there are the usual unexplainable exceptions.

The presence of a distinctly haired "variety" of *glabra*, if indeed a variant, is an interesting sidelight on the *Thaumatomyia* vs. *Chloropisca* controversy (cf. discussion at the end of this paper). Duda attempted to distinguish between the two groups on the basis of this very character of distinct hairs on the mesonotum and scutellum, as opposed to a wholly glabrous surface. Actually I find that

there is a gradual graduation in the development of the hairs, and I cannot agree that the character by itself is adequate even for varietal or specific let alone for generic distinctions, though it is possible that a consistent character or characters may yet be found for infra-specific units.

Certain populations, particularly in California, appeared quite distinct because the cheeks were narrower than usual, though by no means as narrow as the linear cheeks of *apache*. In Californian specimens, the width of the cheeks averages only three-quarters the breadth of the third antennal segment (.57-.86, average .76) and approximately one-fifth the height of an eye (.13-.23, average .19). Besides these proportions, the examples had short but distinct hairs on the mesonotum and scutellum, entirely black third antennal segments, yellow metatarsi on the fore legs, and in about three-fifths of the specimens only one black pleural spot, a large oval spot on the mesopleura. Typical *glabra*, from the eastern states, has a cheek width 1-1.5 times the breadth of the third antennal segment (average 1.15), and .24-.45 times the height of an eye (average .335), besides being more or less glabrous, and having some yellow at the base of third antennal segment, entirely black fore tarsi, and usually three or four large black pleural spots. Here again, the existence of intermediates and various combinations has dictated caution in drawing conclusions on the status of these populations. Probably breeding experiments will be necessary to settle the matter, when time and opportunity are available.

NOTEWORTHY ADDITIONS TO THE KNOWN DISTRIBUTION

Thaumatomyia annulata (Walker) (=*Chloropisca variceps* Loew): now recorded from scattered localities in New Hampshire, Montana, Washington, Manitoba, and Saskatchewan. Southwestern record: Westwood Hills, Los Angeles Co., Calif., March 6, 1933 (N. F. Hardman) [Univ. Calif.]. Two examples (♂, ♀), Cheboygan Co., Mich., Aug. 14, 1935 (H. B. Hungerford) [Kans. Univ.] were "reared from seeds of *Conopholis americana*," the squawroot.

T. g'abra (Meigen): records available from every state except three, from seven Canadian provinces, and from Labrador. One specimen is recorded from Henry Co., Iowa, March 28, 1940 (O. Halvorson) [Ia. Wesleyan Coll.] as reared "from spider egg case," an unusual instance in view of its usual occurrence as a predator of root aphids. A series from Rapids, Alaska, July 18, 1937 (C. B. Philip) shows extreme melanism, the mesonotal stripes almost fused together to form an entirely black mesonotum.

T. grata (Loew): Hillsboro, Ore., Sept. 24, 1938 [Ore. State Coll.]; Mountain Lake, Va., July 17, 1938 (L. J. and M. T. Milne); numerous localities in Minnesota.

T. obtusa (Mall.): one female, Tomahawk Creek in southwestern Presque Isle Co., Mich., July 19, 1942 (C. W. Sabrosky). This is the fifth recorded locality for this rare species.

T. parviceps (Mall.): only fourteen additional specimens of this uncommon species have been seen, from Fayetteville, Ark., July 18 and 19, 1906 (C. F. Adams) [Univ. Ark.]; Newcastle, Ind., August, and Indianapolis, Ind., Aug. 26, 1928 (C. F. Adams) [Purdue Univ.]; Grand Rapids, Mich., July 12, 1937 (Elton Hansens) [Mich. State Coll.]; Carp Lake, Emmet Co., Mich., July 16, 1938 (C. W. Sabrosky); Monroe, Mich., July 4, 1940, Washtenaw Co., Mich., June 30, 1940, and Detroit, Mich., June 16, 1940, and Aug. 17, 1941 (all coll. George Steyskal) [Steyskal Colln.]; Olmstead Co., Minn. (C. N. Ainslie) [Univ. Minn.]; Branchville, N. J., Aug. 5, 1933 (C. H. Curran) [Amer. Mus. Nat. Hist.]. Combined with previous records, these indicate that the species is rather widely distributed in eastern United States (Vt. to Minn.), though rarely taken by collectors.

T. pulta (Adams): Recorded from many additional localities, but seldom

more than one or two specimens from each. It is very closely related to the European species, *T. obscurella* Zetterstedt.

T. pullipes (Coq.): Horse Creek, Wyo., August, 1895 [Kans. Univ.], and from a dozen scattered localities, chiefly in Colorado and New Mexico.

T. rubida (Coq.): numerous additional localities in Oregon, California and Utah. The occurrence in California of another species with reddish stripes means that a more careful scrutiny will be necessary in the future to insure proper separation of the two species possessing the hitherto distinctive color.

THAUMATOMYIA VERSUS *CHLOROPISCA*

A change in the name of a well-known genus with common and frequently recorded species is always unfortunate, even though the reasons are evident. The writer is reluctant to adopt the above change for the dozen described American species in this group, but under the circumstances it seems inevitable. To postpone the adoption of *Thaumatomyia* any longer would serve no useful purpose. Because there is likely to be objection in many quarters, and because most of the references are not readily available, it seems advisable to review the situation in some detail. Actually, there are three separate problems to be solved in arriving at the above conclusion.

(1). Original publication of *Thaumatomyia* Zenker 1833. In a journal commonly referred to as Froriep's Notizen (Notizen aus dem Gebiete der Natur- und Heilkunde, gesammelt und mitgetheilt von Ludwig Friedrich v. Froriep), there appeared in vol. 35, no. 767, dated Jan., 1833, a plate containing a number of figures, chiefly embryological. In the lower left hand corner, however, figures 45 to 57 inclusive present the details of some dipterous insect, but no key or explanation of these figures can be found. In a later issue, No. 770, under the same date of Jan., 1833, there appeared on p. 344 a paragraph mixed with others of miscellaneous character under the heading "Miscellen", as follows:

"Die Figuren 45 bis 57 auf der mit Nro. 767 ausgegebenen Tafel. Sie stellen eine neue Art Eliegen vor, die in ungeheurer Zahl in der Weimarischen Bibliothek gefunden worden waren, und welche Hr. Prof. Zencker, *Thaumatomyia prodigiosa* genannt hat. Die Erläuterung welche, wie die Abbildungen, Hr. Prof. Z. die Güte gehabt hat mir zu überschicken, habe ich unglücklicherweise verlegt; sie werden folgen, sobald ich sie wieder finde." Apparently the lost manuscript was never recovered, for nothing further appeared in the journal.

It seems evident, therefore, that although no complete description was printed, the generic and specific names were published and accompanied by an "indication", in this case a definite reference to previously published illustrations, and by certain data on the circumstances of its appearance ("in ungeheurer Zahl"). The names must, therefore, be regarded as valid and available. (Art 25, a, b, and Opinion 1, of the International Rules). Sack (1935, Ent. Rundschau, 52: 195-197) has objected to *Thaumatomyia* on the ground that it is a *nomen nudum*, but this is impossible since there is a definite reference to illustrations of the species.

(2) The identity of *Thaumatomyia prodigiosa* Zenker. Granted the nomenclatorial availability of the names, the second question involves a zoological problem, the correct identity of the species *T. prodigiosa*. Contrary to Sack's opinion, I believe that it is obvious from the figures that the species is a *Chloropisca* as the latter has been widely known. Even though the illustrations leave much to be desired in the way of accuracy of detail and of diagnostic characters (as do many early figures), still Fig. 51 (a side view with the wings removed) shows the disk of the scutellum distinctly flattened, which is the conspicuous character of *Chloropisca*. The figures would place it in that genus.

Further, as Duda (1935, Ent. Rundschau, 53:50-52) pointed out in reply to Sack's objections, the reference in the original notice to the monstrous (ungeheurer) number of flies found in the library fits only one European species,

widely known as *Chloropisca notata* (Meigen) and rather frequently recorded as suddenly occurring by the millions on the windows or ceilings of houses or other buildings. The figures of *T. prodigiosa* agree fairly well with *C. notata*, differing as might be expected in such a tiny fly in the accuracy of delineation. Bezzi (1908, Wien. Ent. Zeit., 27:293) long ago suggested the probability of this synonymy, and Duda (1933) adopted this view in the latest revision of the European species. I agree with Duda that the figures and the point of its occurrence in huge numbers indicate the common identity of *T. prodigiosa* Zenker and the species commonly known as *Chloropisca notata* (Meigen). Since the latter specific name has priority, the combination will be *Thaumatomyia notata* (Meigen).

(3) The status of *Thaumatomyia* Zenker 1833 and of *Chloropisca* Loew 1866. The third and last problem is also a question of zoology rather than of nomenclature. If *T. prodigiosa* and *C. notata* are synonymous, then *Chloropisca* (in the sense of Loew, Becker et al) =*Thaumatomyia*, the latter being the prior name. However, the genotype of *Chloropisca* Loew is *C. glabra* (Meigen). Duda (1933) utilized the glabrous appearance of the thorax and scutellum of the latter species as a distinction between the two genera, and thereby recognized both *Chloropisca* and *Thaumatomyia* as valid, restricting the former to the glabrous species and the latter to those with numerous hairs. Nevertheless, *C. glabra* (said by Duda to be "gänzlich unbehaart") and its relatives actually have fine inconspicuous hairs on the notum and scutellum, and the glabrous appearance is only a matter of lesser degree of development.

After a careful check of many of the European and all of the American species, I cannot agree that the character used by Duda is valid for separation of the species in the group. In effect, therefore, I unite all the species into one group (as did Loew and Becker), and the oldest valid name for the group is *Thaumatomyia* Zenker. Our American species will therefore appear in new combinations as *T. glabra* (Meigen), *T. grata* (Loew), *T. appropinqua* (Adams), etc. For the sake of completeness it may be noted that even if Duda's distinction were held to be valid, the only American species to be retained as *Chloropisca* would be *C. glabra* (Meigen), *C. appropinqua* (Adams), *C. pullipes* (Coq.) and *C. bistriata* (Walk.). The other described species would still pass to *Thaumatomyia* on the basis of the numerous short hairs covering the mesonotum and scutellum.

(4) Malloch (1938, Proc. Linn. Soc. N. S. Wales, 63:353) has introduced a fourth factor into the general problem: "I incline to the restriction of the genus to those species in which the mesopleura is microscopically haired on the posterior half or less." Both genotypes recognized by Duda (*Thaumatomyia notata* and *Chloropisca glabra*) have these mesopleural hairs. Of the species examined, the character holds good for all but two, *Chloropisca parviceps* Malloch and C. *obtusa* Malloch. These species have an entirely glabrous mesopleura, and would be referred elsewhere if Malloch's criterion were applied. Because of the essential similarity to other species, I should hesitate to segregate these two on the basis of that one feature alone. It is true that they appear somewhat different because of the convex sides of the frontal triangle, the linear cheeks, and the small crossvein opposite the middle of the discal cell. Some of these same features appear elsewhere in other combinations, however; e. g., *T. sulfurifrons* (Duda) has linear cheeks, but has mesopleural hairs and a different wing venation, and *T. notata* itself has a wing similar to the type found in *parviceps* and *obtusa*, and also has sublinear cheeks. Hence, I cannot accept the character by itself as being of generic significance in this case, and I refer *parviceps* and *obtusa* to *Thaumatomyia* along with the other American species.

NOTES

THE CLOVER SEED WEEVIL, *TYCHIUS PICIROSTRIS* (FAB.), IN BRITISH COLUMBIA (COLEOPTERA)

This tiny gray weevil, the true *Tychius picirostris* (Fabricius), was first reported from North America in 1934 by W. W. Baker (J. Econ. Ent., 27 (5):1103-1104). Baker gave notes on its hosts in western Washington and quoted L. L. Buchanan (in litt.) that specimens from eastern North America recorded as *picirostris*, are a distinct species, *T. griseus* Schaeffer.

In June, 1937, *T. picirostris* was found swarming in the flower heads of white Dutch clover in the Coldstream district of Vernon, where they were laying eggs in the blossoms. Only a few beetles were seen on nearby alfalfa and red clover. The following additional British Columbia locality records are from specimens in the collection of the late Ralph Hopping of Vernon: Midday Valley, Merritt, 15.VI.24 (K. F. Auden); Agassiz, 1.IX.25 (R: Glendenning); Vancouver, 11.VI.30 and 2.VII.30 (Hugh B. Leech), on *Salix* sp.; Aspen Grove, 11.VI.33 (K. Graham), on *Pinus contorta latifolia*. Mr. Leech tells me that *picirostris* has been beaten from white pine and spruce by men co-operating in the Forest Insect Survey.

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FLICKERS EAT INJURIOUS INSECTS

To determine which injurious insects were being fed upon locally by the red shafted flicker, *Colaptes cafer collaris* Vigors, 16 specimens were collected from fence-rows, trees and poles during the years 1935 through 1941. Most of the stomach contents consisted of insects, with adults, pupae and larvae of ants being most abundant; Formicidae was the only family of insects represented in every stomach examined. In addition to being farm and garden pests under Utah conditions, harvester ants in particular are serious range pests, keeping bare large areas of vegetation around each of the numerous mounds.

Recognizable insect food consisted of: 5,163 Hymenoptera, 3,747 of these being adults and 1,416 being pupae and larvae of ants. The stomach of one flicker collected on July 15, 1940, near Logan, contained 785 adult *Formica neorufibarbis* Emery (Det. A. C. Cole) and 932 larvae and pupae, besides one alfalfa weevil and 13 weed seeds. This stomach content weighed 7.5 grams. Many species of ants were present in the stomachs examined, including a large number of *Pogonomyrmex occidentalis* (Cresson) and *Camponotus* spp.

In addition to the Hymenoptera, there were: 1 of Thysanura; 1 nymphal grasshopper, 4 grasshopper eggs and 2 cricket eggs; 16 of Isoptera; 6 of Hemiptera, 2 being *Lygus hesperus* Knt., 1 *L. elisus* Van D. and 2 *Nysius ericae* (Schill.); 1 of Homoptera, the aphid *Clavigerus bicolor* (Oest.); 80 of Coleoptera, 70 being adults and 2 larvae of Scolytidae in one stomach, 2 of *Phytonomus posticus* (Gyllenhal) and 1 scarabaeid, *Aphodius* sp.; 2 larval Lepidoptera; 8 larval Diptera and 1 adult *Chloropisca glabra* (Meig.). In addition there were 3 spiders, 54 seeds, mostly of weeds, a few grains of gravel and some plant fragments. The food found in these stomachs consisted principally of injurious species.

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